UMM AL-QURA UNIVERSITY

College of Computer and Information Systems

Computer Engineering Department

1403311

Electronics

Lab Manual

Student Name: ___________________________________

Student ID: ______________________________________

Section: ________________ Group: __________________

Session (Fall / Spring / Summer) ____________________

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Revised By:	Engr. Muhammad Yousuf Irfan Zia	2013
Reviewed By:	______________________	__________
Approved By:	______________________	__________

Umm Al-Qura University

Computer Engineering Department

LABORATORY SAFETY GUIDELINES

A. General Laboratory Safety Rules

1. **Personal Safety**
   - Be familiar with the electrical and fire hazards associated with your workplace.
   - Be as careful for the safety of others as for yourself. Think before you act.
   - Be tidy and systematic.
   - Avoid bulky, loose or trailing clothes. Avoid long loose hair.
   - No one is allowed to enter in the lab area bare foot due to increased risk of electric shock.
   - Remove metal bracelets, rings or watchstraps when working in the laboratories.
   - Avoid working with wet hands and clothing.

2. **Food, Beverages and Smoking**
   - Due to the increased risk of electric shock, no drinking of beverages, consumption or storage of any kind of food is allowed in the laboratory.
   - Smoking is prohibited in all laboratories in all timings.

3. **Soldering**
   - No one is allowed to do soldering in any of the computer engineering laboratories except the graduation project design laboratory.
   - Anyone doing soldering in the graduation project design laboratory must wear appropriate apparel, socks, gloves, covered shoes and safety goggles to prevent the possibility of severe burns resulting from the splashing or dripping of hot liquefied solder into the face and eyes or on to the exposed skin on the chest, hands, legs, and feet.
   - Students who are not so properly attired for these tasks will NOT be allowed to perform any type of soldering in the graduation project design laboratory.

4. **Laboratory Operating Hours**
   - Students are never allowed to work alone in any lab area other than scheduled laboratory operating hours unless either a Lab T/A or Course Instructor is present inside that lab area.
   - The laboratory operating hours for students are posted on the entrance doorway and on the notice board of computer engineering department.

5. **Power Supply Related Safety**
   - Voltages above **50-VAC** or **120-VDC** are always dangerous.
   - Extra precautions should be considered as voltage levels are increased.
   - Never make any changes to circuits or mechanical layout without first isolating the circuit by switching off and removing connections to power supplies.

6. **Laboratory Equipment**
   - Lab equipment may not be removed from the Computer Engineering lab areas without the permission of the Laboratory Supervisors.
   - Laboratory bench equipment (except for some lab bench computers) must be turned off before closing down the lab area for the day.
   - Never open (remove cover) of any equipment in the laboratories.
   - Never "jump," disable, bypass or otherwise disengage any safety device or feature of any equipment in the laboratories.
   - Laboratories shall be locked when unoccupied.

7. **Waste Management Safety**
   - Know the correct handling, storage and disposal procedures for batteries, cell, capacitors, inductors and other high energy-storage devices.

8. **Equipment Safety**
   - Before equipment is energized ensure, circuit connections and layout have been checked by a Teaching Assistant (TA) and all colleagues in your group has given their consent.
   - Experiments left unattended should be isolated from the power supplies. If for a special reason, it must be left on, a barrier and a warning notice are required.
   - Equipment found to be faulty in any way should be reported to the lab supervisor and taken out of service until inspected and declared safe.

9. **Equipment Accessories**
   - Use extension cords only when necessary and only on a temporary basis.
   - Request new outlets if your work requires equipment in an area without an outlet.
   - Discard damaged cords, cords that become hot, or cords with exposed wiring.

B. Electrical and Fire Emergency Responses

1. **Police, Fire or Medical Emergency**
   - Use the telephone located in the laboratory area and press **0-996** to notify police, fire, and ambulance for emergency help.
   - Everyone present in the laboratory area shall be familiar with the locations and operation of safety and emergency equipment, including but not limited to, fire extinguishers, first aid kits, emergency power off system, fire alarm pull stations, and emergency telephones.

2. **Electric Shock**
   - When someone suffers serious electrical shock, he may be knocked unconscious.
   - If the victim is still in contact with electrical current, immediately turn off the electrical power source.
   - If you cannot disconnect the power source, depress the Emergency Power Off switch.
   - Do not touch a victim that is still in contact with a live power source; you could be electrocuted! Have someone call for emergency medical assistance immediately. Administer first-aid, as appropriate.

3. **Electrical Fire**
   - If an electrical fire occurs, try to disconnect the electrical power source, if possible.
   - If the fire is small and you are not in immediate danger; and if you have been properly trained in fighting fires, use the correct type of fire extinguisher to extinguish the fire.
   - When in doubt, push in the Emergency Power Off button.
   - **NEVER use water to extinguish an electrical fire**.

4. **Emergency Power Off**
   - Every lab is equipped with an Emergency Power off System.
   - When this switch is depressed, electrical power to the lab will shut off, except for lights.
   - Only authorized personnel are permitted to reset power once the Emergency Power Off system has been engaged.

5. **Building Evacuation in Emergency**
   - Everyone present in the laboratory should be familiar to emergency exits & way out plans.
   - Use the nearest exit doorway from lab area closest to the stairwell to exit the building.
   - Follow the Emergency Exit Signs posted in the hallways. Do not use elevators.
   - Lab Teaching Assistants (T/As) or Instructor shall make sure all persons are out of the laboratory area and follow the directions posted at each doorway to the laboratory area.

The above general laboratory safety rules are designed to safeguard you and your co-workers, fellow students and colleagues and are a minimum requirement for individuals working in the computer engineering laboratories at Umm Al-Qura University, Makkah Al-Mukarramah. Specialized training and rules may apply depending on type and scope of activities involved.

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Introduction to NI ELVIS-II Board

Objective:

The objective of this experiment is to introduce NI ELVIS II board.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.

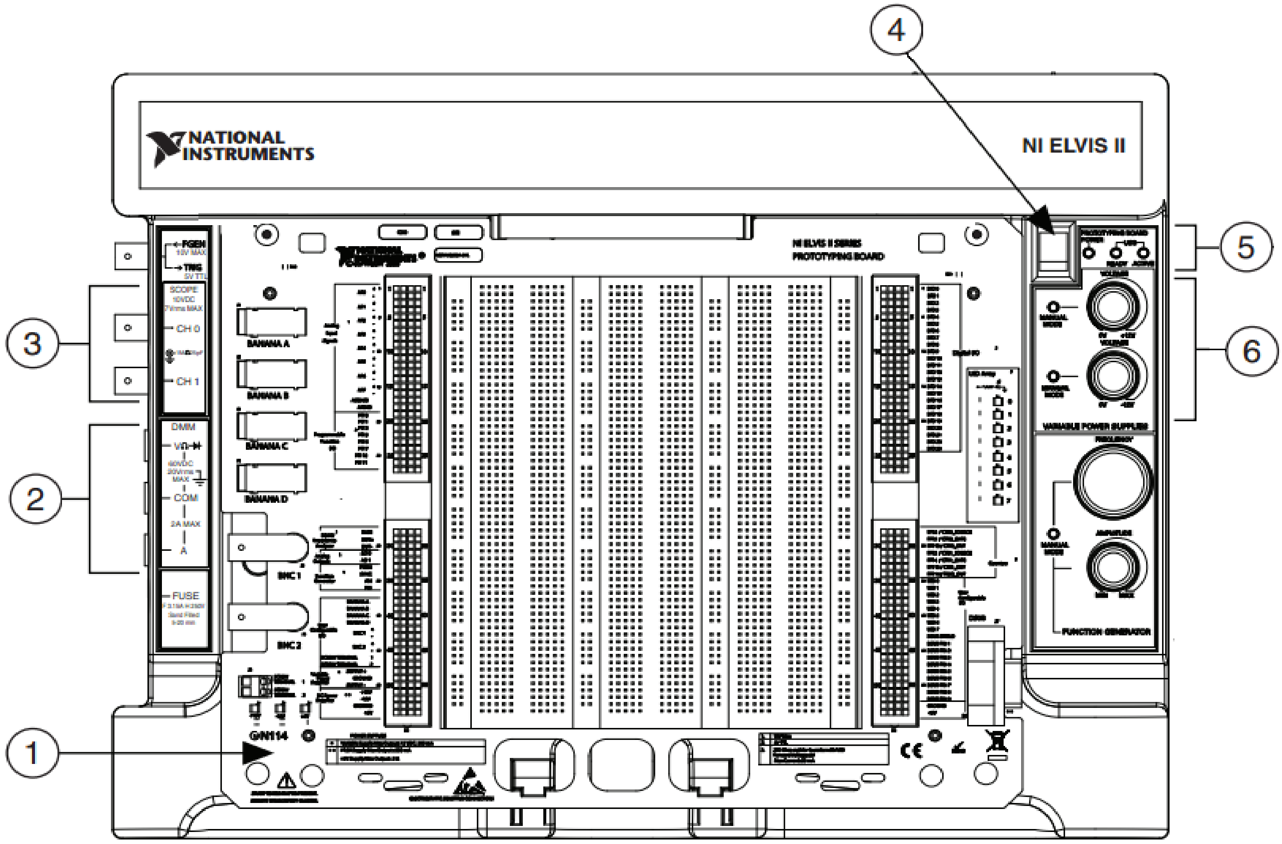

Figure 1.1: NI ELVIS II Workstation parts locator diagram.

NI ELVIS II Parts

1. NI ELVIS II Series Prototyping Board.
2. Digital Multi Meter (DMM) Connectors.
3. Oscilloscope Connectors.
4. Prototyping Board Power Switch.
5. Status LEDs.
6. Variable Power Supply Manual Controls.

The workstation has following important indicators, controls, and connectors:

USB LEDs

- **Ready**: Indicates that the NI ELVIS II Series hardware is properly configure and ready to communicate with the host computer.
- **Active**: Indicates activity on the USB connection to the host computer.

Prototyping Board Power Switch and LED

- Controls the power to the prototyping board.

Fixed Power Supplies

- **+5V**
- **+15V**
- **-15V**

Variable Power Supplies Controls

- **Positive Voltage Adjust Knob**: Controls the output voltage of the positive variable power supply from 0v to +12V
- **Negative Voltage Adjust Knob**: Controls the output voltage of the negative variable power supply from 0v to -12V

DMM Connectors

- 60VDC, 20Vrms max
- Voltage
- Resistance
- Diode
- Banana Jack (red): The positive input for voltage based DMM functionality.
- Common Banana Jack (black): The common reference connection for DMM voltage, current, resistance, and diode measurement.
- Current Banana Jack (red): The positive input for DMM current measurement.

Oscilloscope Connectors

- 10VDC, 7V rms max
- CH-0 BNC Connector: The input for channel 0 of the oscilloscope.
- CH-1 BNC Connector: The input for channel 1 of the oscilloscope.

Procedure:

1. Connect the NI ELVIS II workstation to your computer using the supplied USB cable.
2. Turn on the computer and power up NI ELVIS II workstation.
3. Click on the NI ELVIS II **Instrument Launcher Icon** or shortcut. A strip of NI ELVIS instruments appears on the screen.

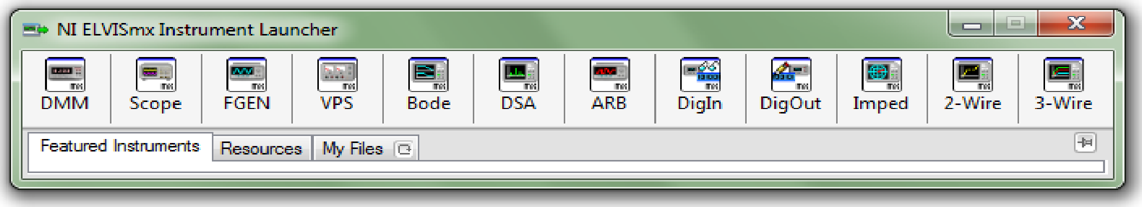

Figure 1.2: NI ELVIS II Instrument Launcher Icon Strip

4. Connect two banana-type leads to the digital multi-meter (DMM) inputs [VΩ⊣▶⊢] and **[COM]** on the left side of the workstation.
5. Connect other ends to one of the resistors.
6. Click on the DMM icon within the NI ELVIS II Instrument Launcher to select the **digital multi-meter**.

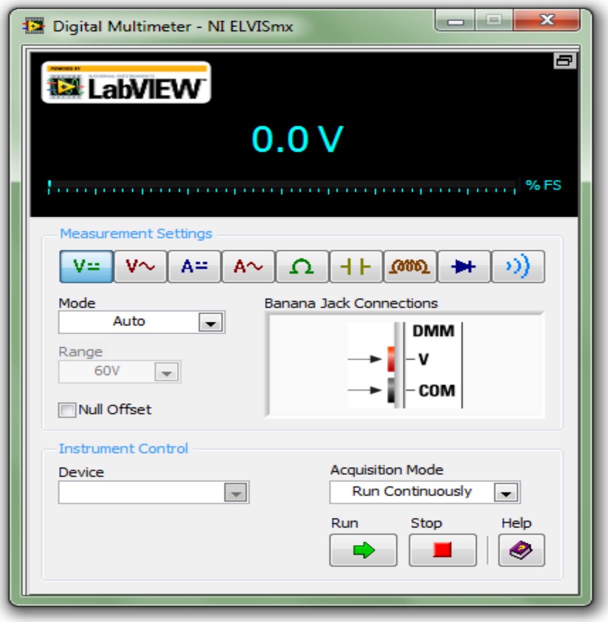

Figure 1.3: Digital Multi-meter, (DMM)

7. The DMM can be used in variety of operations such as voltage, current, resistance, and capacitance measurement.
8. Click **Ohm button** to select the DMM to measure resistance then click **RUN** to measure the value of resistor.

9. Click on the VPS icon within the NI ELVIS II Instrument Launcher to select the variable power supply.

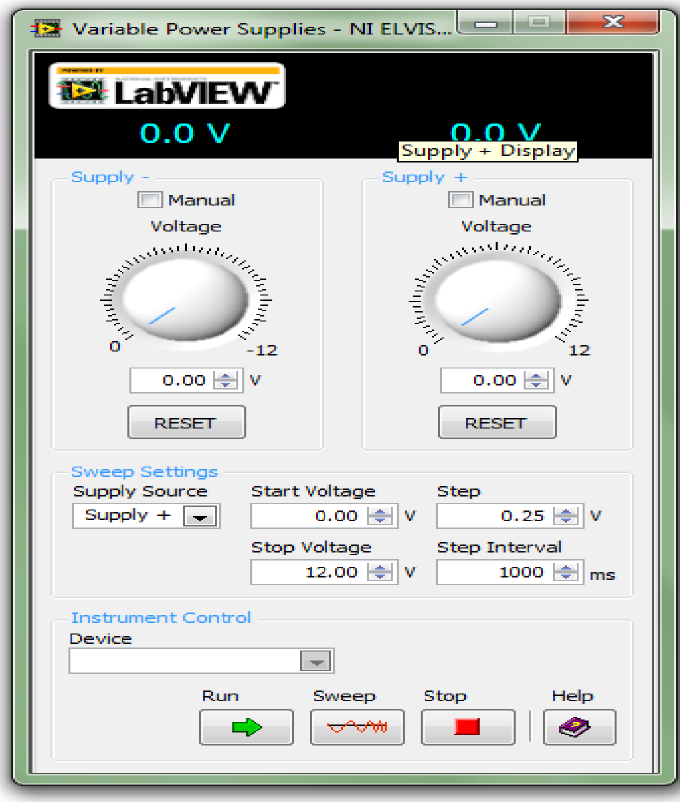

Figure 1.4: Variable Power Supply (VPS)

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a. The measured value of **+5V** fixed power supply is ______________________ V.

b. The measured value of **+15V** fixed power supply is _____________________ V.

c. The measured value of **-15V** fixed power supply is ______________________V.

d. The measured range **positive** variable supply is from ________ V to ________V.

e. The measured range **negative** variable supply is from ________ V to _______ V.

f. The measured value of R1 using DMM is ________________ Ω.

g. The observed value of R1 using color codes is _____________ Ω.

h. The measured value of R2 using DMM is _________________ Ω.

i. The observed value of R2 using color codes is _____________ Ω.

Introduction to Diode

Objective:

The objective of this experiment is to observe the characteristics of PN Junction Diode.

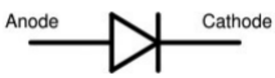
Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Diode and Resistor.

Background:

PN junction is a boundary between two types of semiconductor materials inside single crystal of semiconductor created by doping. It is an elementary building blocks of most semiconductor devices such as diodes, transistors etc. In this experiment PN Junction diode characteristics are observed. A Silicon diode is used as forward biased and curves are plotted.

Procedure:



Part I

1. Identify Anode and Cathode of the diode by observing sliver strip.
2. Identify Anode and Cathode of the diode using multi-meter.
3. The forward biased resistance of diode is _____________ Ω.
4. The reverse biased resistance of diode is ______________ Ω.

Part II

1. Connect the circuit as shown in figure 2.1.
2. Measure and record values in the table 2.1.
3. Sketch diode characteristics curve on the graph paper.

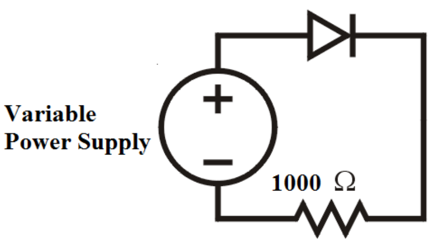


Figure 2.1: Diode Circuit.

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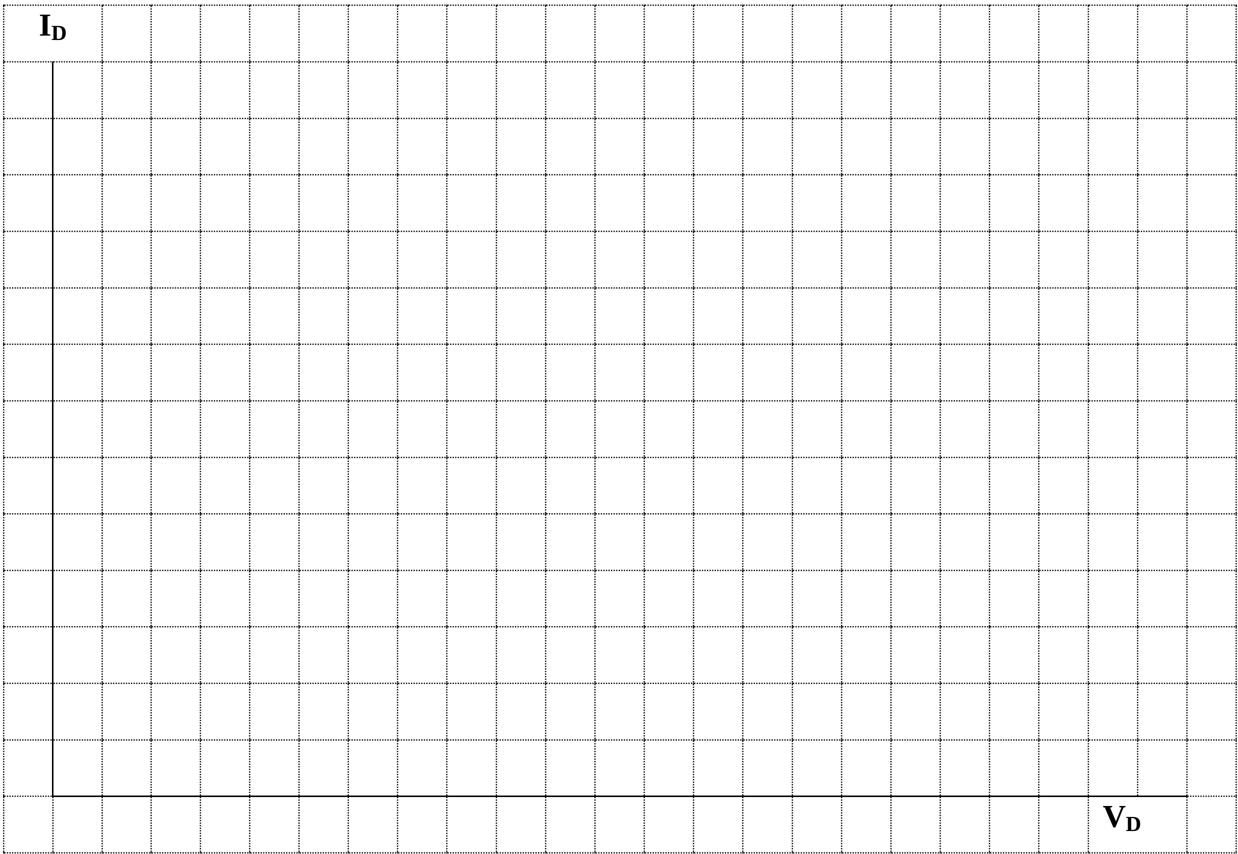
Table 2.1: Voltage drop across diode and diode current.

Power Supply (V)	**Voltage Drop (V_D)**	**Current I_D (mA)**
0.0V		
0.2V		
0.4V		
0.6V		
0.8V		
1.0V		
1.2V		
1.4V		
1.6V		
1.8V		
2.0V		



Half-wave Rectifier (with and without filter)

Objective:

The objective of this experiment is to understand the working of half wave rectifier circuit.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Diode, Resistor, Capacitor.

Background:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The simple process of rectification produces a type of DC characterized by pulsating voltages and currents (although still unidirectional).

Half-wave rectification requires single diode. In half wave rectification either the positive or negative half of the AC wave is passed, while the other half is blocked, due to this reason the mean voltage is lower. Half-wave rectifiers produce more ripple than full-wave rectifiers, and much more filtering is needed to eliminate harmonics of the AC frequency from the output.

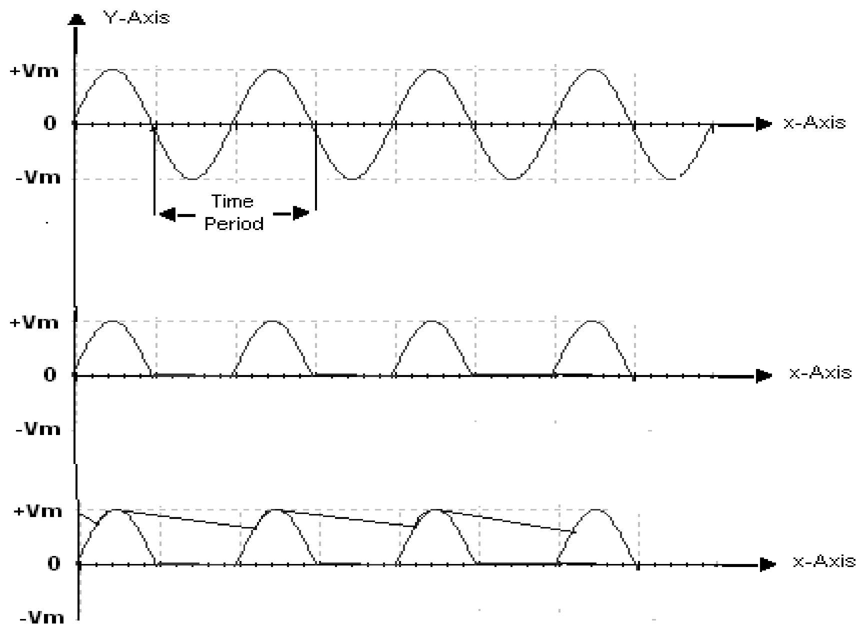


Figure 3.1: Half-wave rectifier waveform (with and without filter).

Procedure:

Part I: Half-wave rectifier (without filter)

1. Connect the circuit as shown in the figure 3.2.
2. Launch function generator and set 5Vpp, 50 Hz, Sine wave as shown in the figure 3.3.
3. Launch oscilloscope and select channel AI0 for input and AI1 for output.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper.

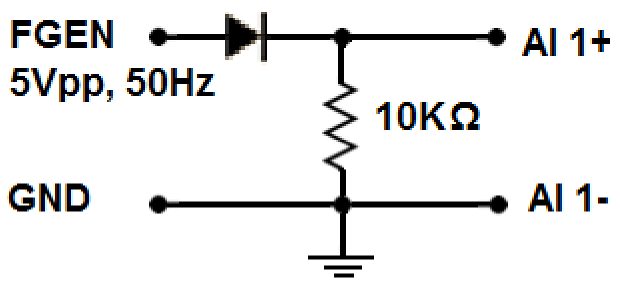


Figure 3.2: Half-wave rectifier circuit (without filter)

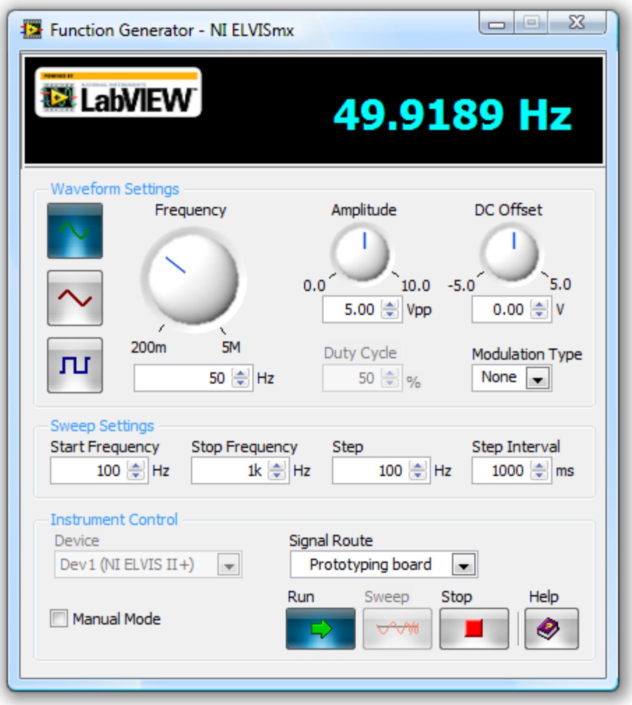


Figure 3.3: NI Elvis II Function Generator

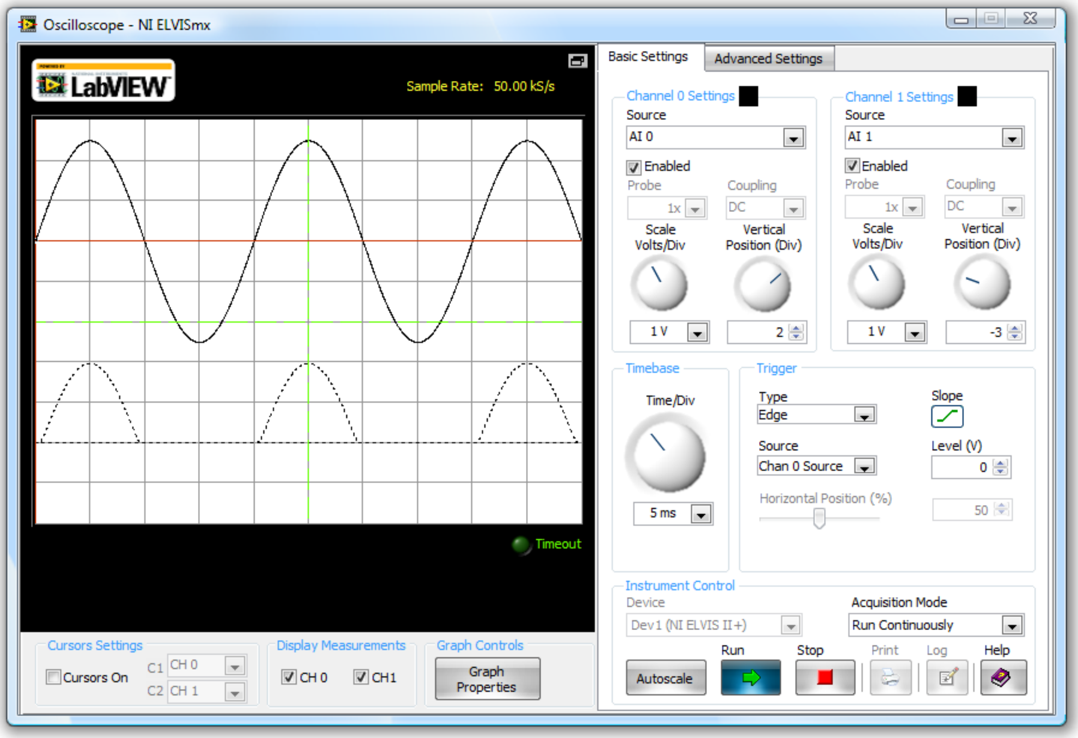


Figure 3.4: Half-wave rectifier waveform (without filter) on oscilloscope.

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Calculations:

$V_{rms} = \frac{V_{Peak}}{2} =$

$V_{dc} = \frac{V_{Peak}}{\pi} = \frac{\quad}{3.142} =$

Part II: Half-wave rectifier (with filter)

1. Connect the circuit as shown in the figure 3.5.
2. Launch function generator and set 5Vpp, 50 Hz, Sine wave as shown in the figure 3.6.
3. Launch oscilloscope and select channel AI0 for input and AI1 for output.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper.

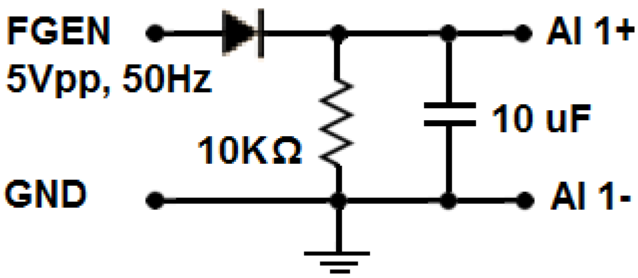

Figure 3.5: Half-wave rectifier circuit (with filter)

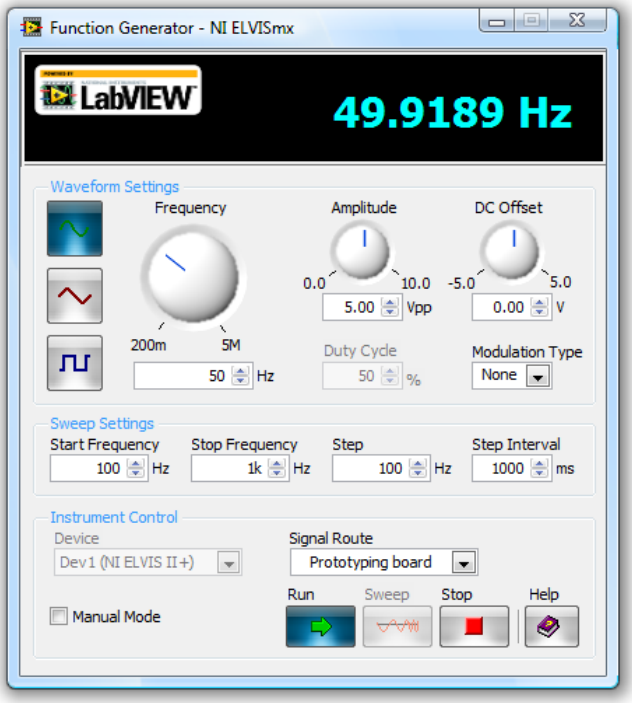

Figure 3.6: NI Elvis II Function Generator

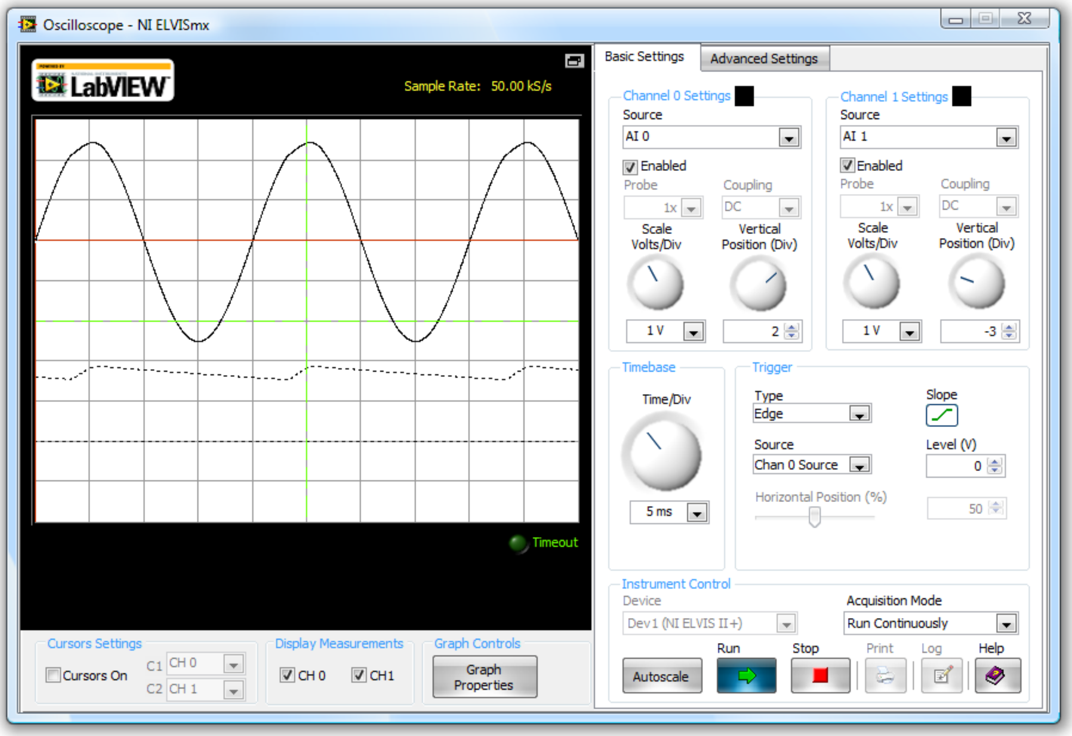

Figure 3.7: Half-wave rectifier waveform (with filter) on oscilloscope.

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Full-wave Rectifier (with and without filter)

Objective:

The objective of this experiment is to understand the working of full wave rectifier circuit.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Diodes, Resistor, Capacitor.

Background:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The simple process of rectification produces a type of DC characterized by pulsating voltages and currents (although still unidirectional).

A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Full-wave rectification converts both polarities of the input waveform to DC (direct current), and yields a higher mean output voltage. Two diodes and a center tapped transformer, or four diodes in a bridge configuration and any AC source are needed.

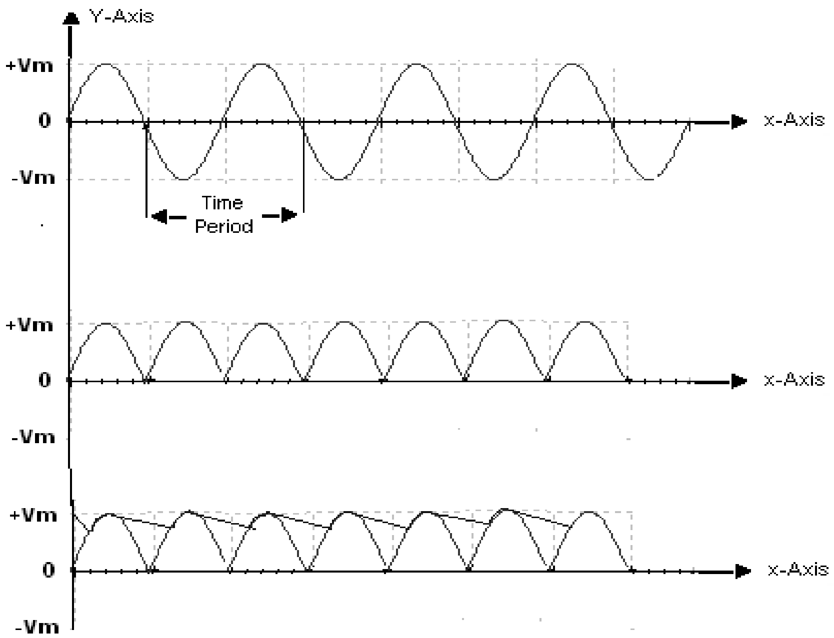

Figure 4.1: Full-wave rectifier waveform (with and without filter).

Procedure:

Part I: Full-wave rectifier (without filter)

1. Connect the circuit as shown in the figure 4.2.
2. Launch function generator and set 5Vpp, 50 Hz, Sine wave as shown in the figure 4.3.
3. Launch oscilloscope and select channel AI0 for input and AI1 for output.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper

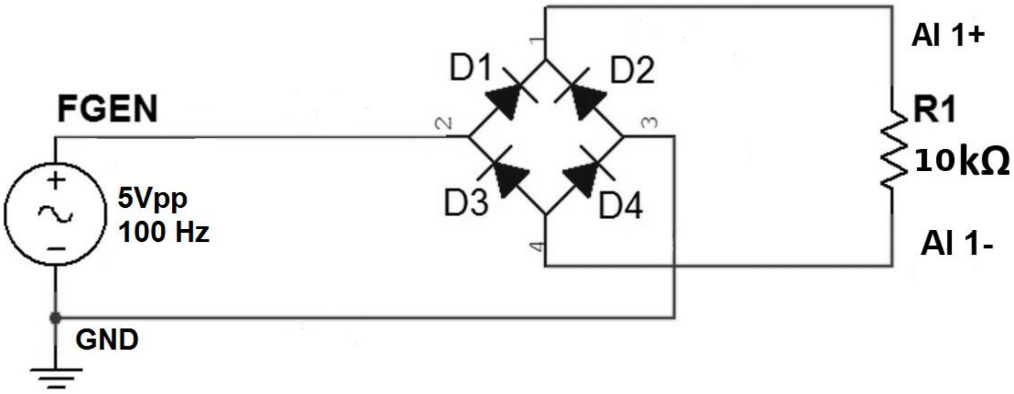

Figure 4.2: Full-wave rectifier circuit (without filter)

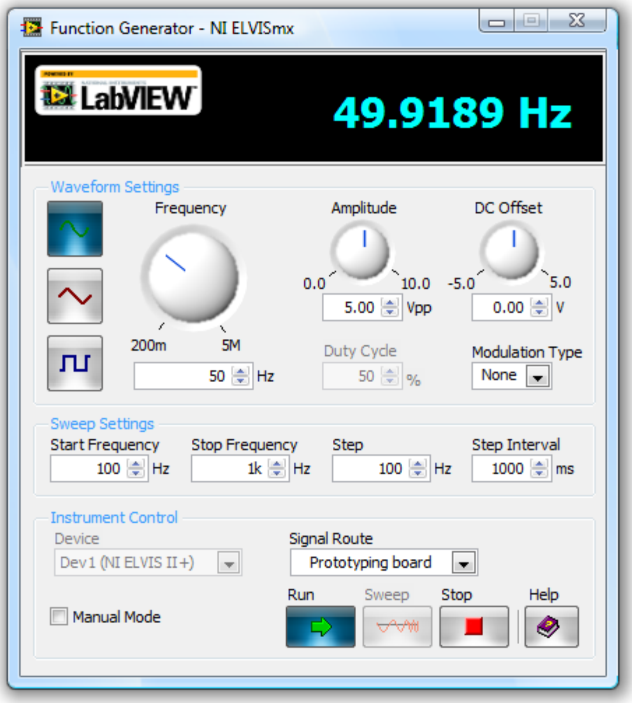

Figure 4.3: NI Elvis II Function Generator

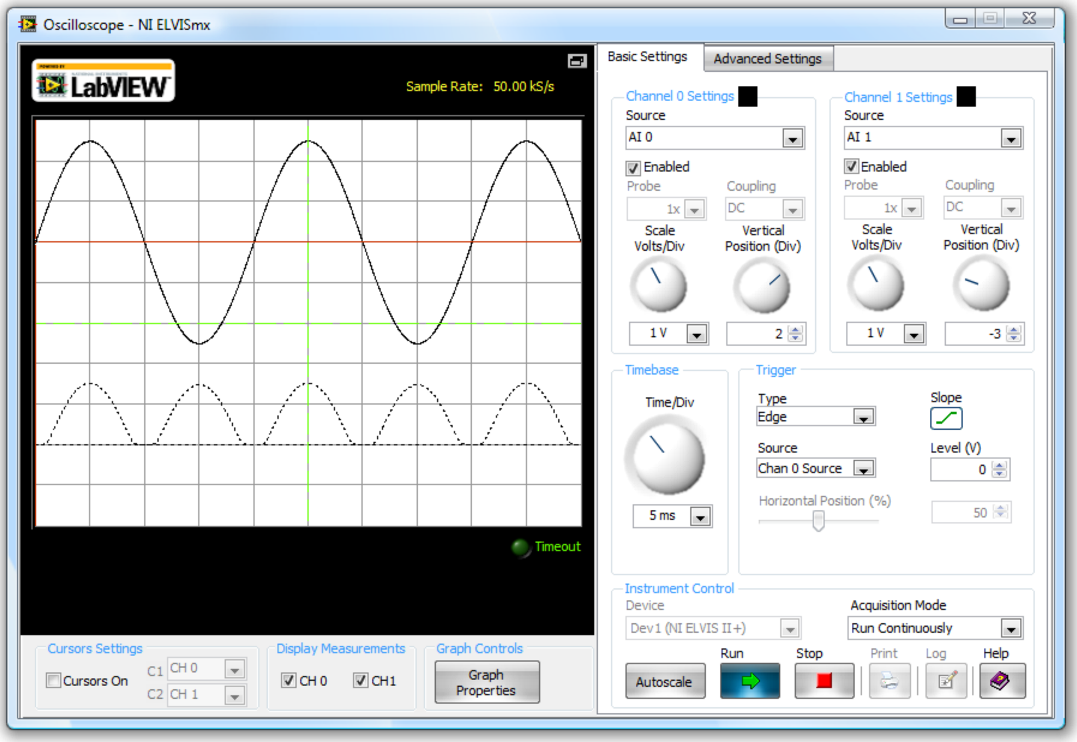

Figure 4.4: Full-wave rectifier waveform (without filter) on oscilloscope.

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Calculations:

$$V_{rms} = \frac{V_{Peak}}{\sqrt{2}} = \frac{\qquad}{1.414} =$$

$$V_{dc} = V_{dc} = \frac{2 \times V_{Peak}}{\pi} = \frac{\qquad}{3.142} =$$

Part II: Full-wave rectifier (with filter)

1. Connect the circuit as shown in the figure 4.5.
2. Launch function generator and set 5Vpp, 50 Hz, Sine wave as shown in the figure 4.6.
3. Launch oscilloscope and select channel AI0 for input and AI1 for output.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper

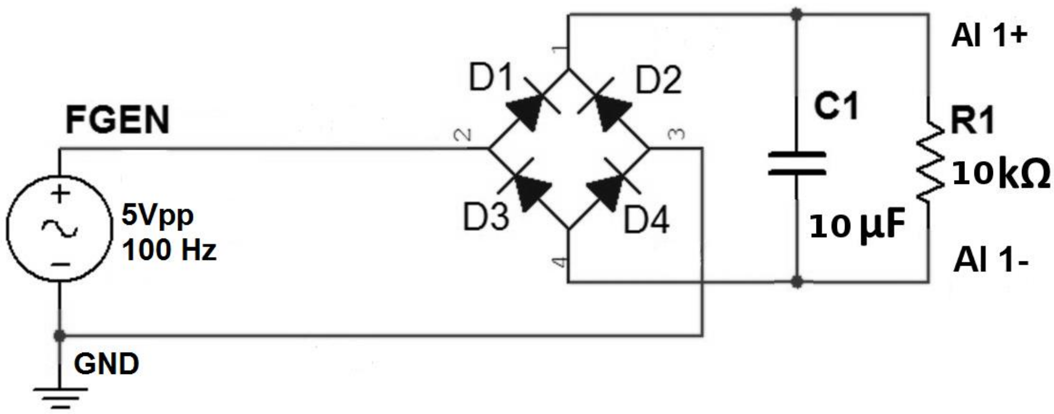

Figure 4.5: Full-wave rectifier circuit (with filter)

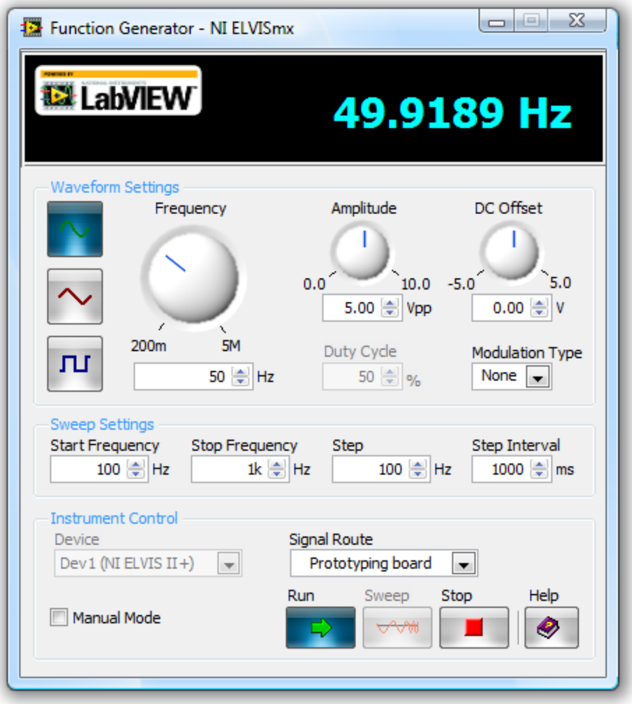

Figure 4.6: NI Elvis II Function Generator

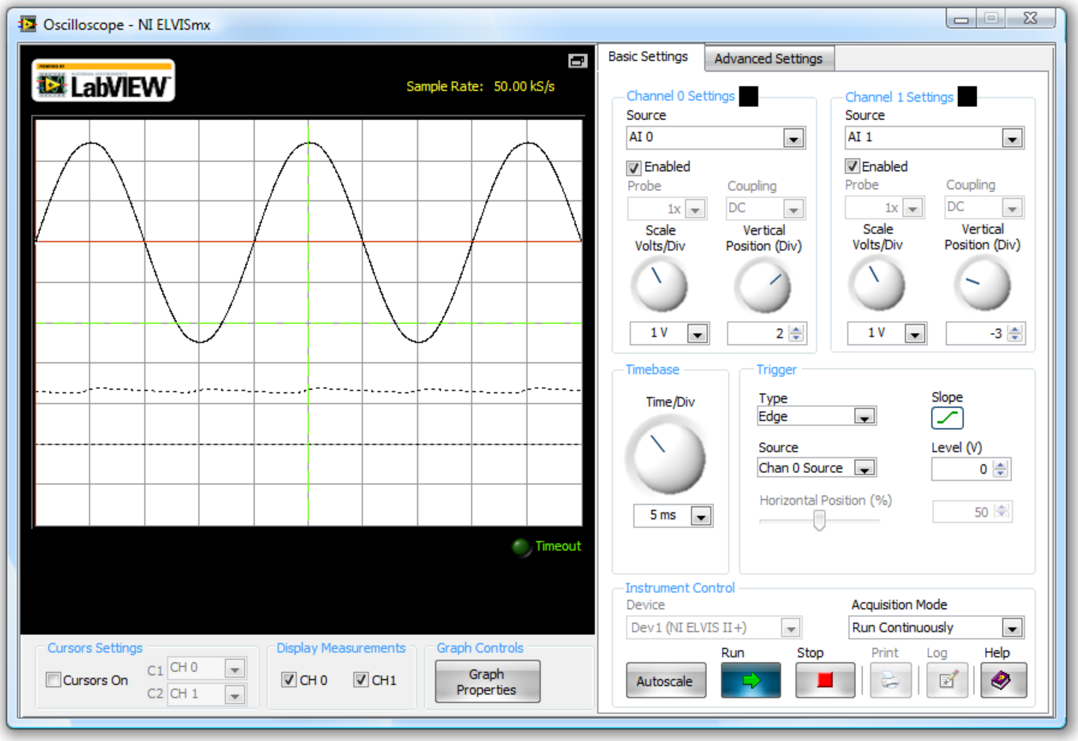

Figure 4.7: Full-wave rectifier waveform (with filter) on oscilloscope.

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Zener Diode Characteristic

Objective:

The objective of this experiment is to study Zener Diode Characteristics

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Zener Diode and Resistors.

Background:

A zener diode is heavily doped p-n junction diode, specially made to operate in the break down region. A p-n junction diode normally does not conduct when reverse biased, but if the reverse bias is increased, at a particular voltage it starts conducting. This is called break down voltage. To avoid high current a series resistor is connected with zener diode. Once diode starts conducting it maintains almost constant voltage across the terminals. It is used as voltage regulator.

Procedure:

1. Connect the circuit as shown in the figure 5.2.
2. Launch variable power supply.
3. Increase voltage step by step and record values in the table 5.1.
4. Repeat steps 1 to 3 for figure 5.3.
5. Sketch the waveform(s) on the graph paper.

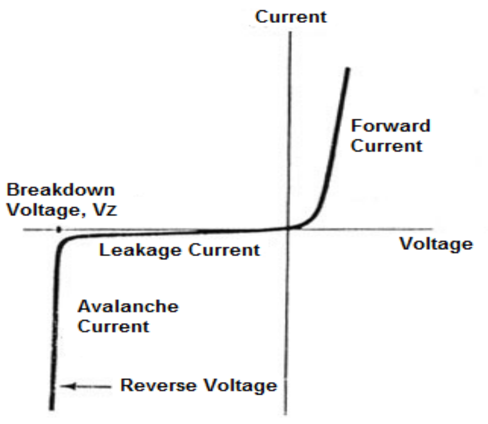

Figure 5.1: Zener diode I-V characteristic curve.

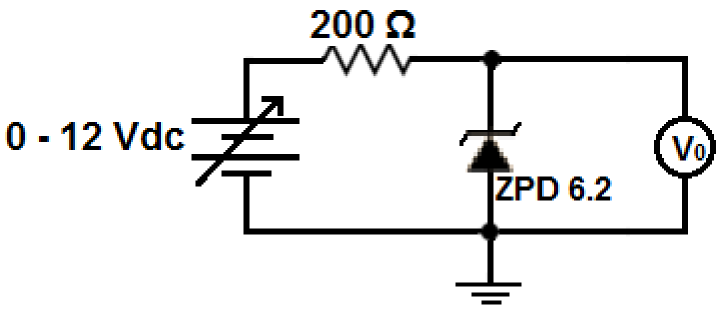

Figure 5.2: Zener diode circuit. (without load).

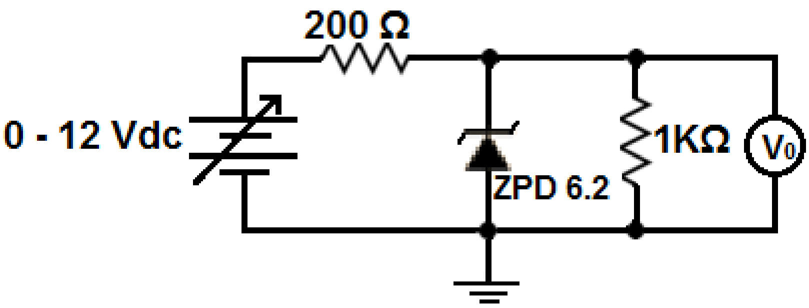

Figure 5.3: Zener diode circuit (with load).

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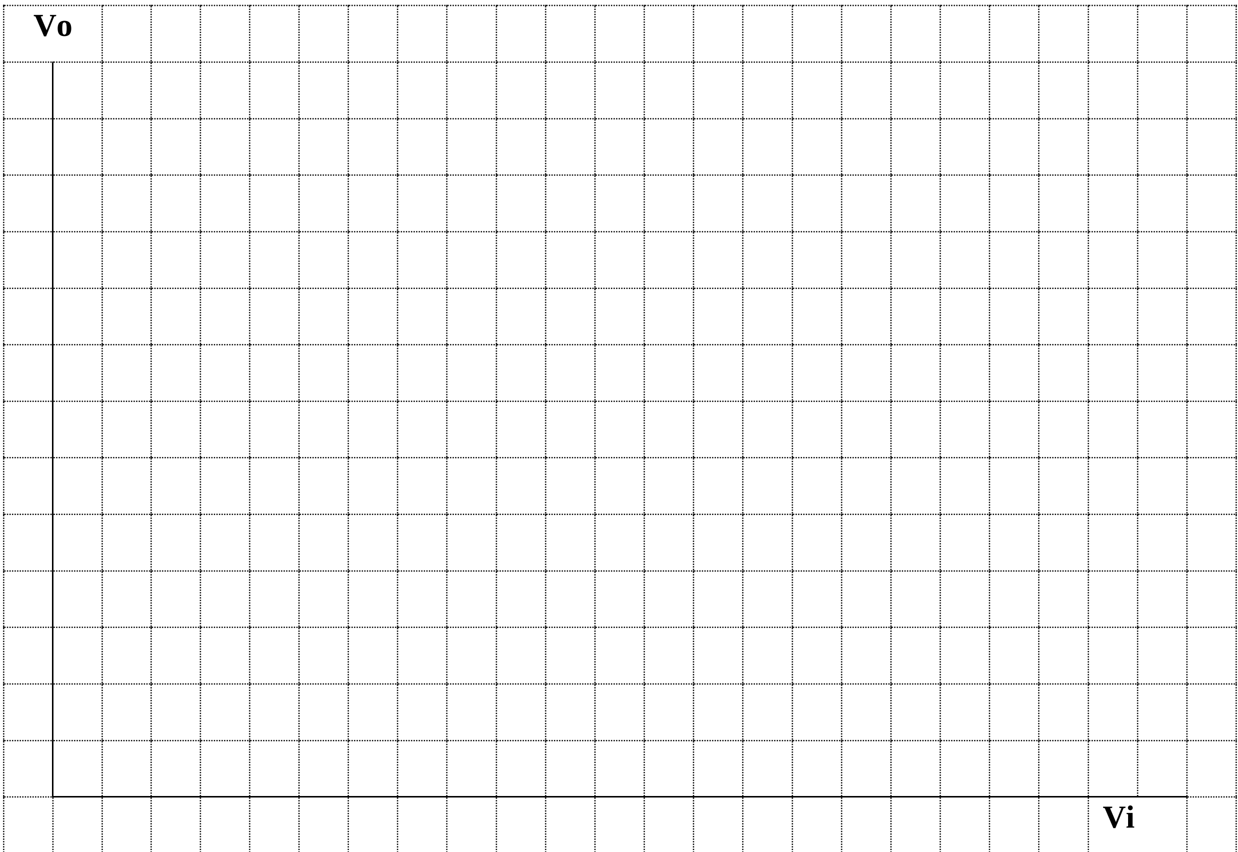
Example:

A 5V stabilized power supply is required to be produced from a 12V DC input source. The maximum power rating $\mathbf{P_Z}$ of the zener diode ZPD6.2 is **500mW**. Using the zener regulator circuit above calculate zener current at **1KΩ** load resistor.

1. From datasheet given that the power dissipation of ZPD6.2: $P_Z = 500mW$
2. Maximum current flowing through the zener diode: $I_{\max} = \dfrac{Watts}{Voltage} = \dfrac{0.5W}{6.2V} = 80.6mA$
3. Minimum value of series resistor: $R_S = \dfrac{V_S - V_Z}{I_Z} = \dfrac{12V - 6.2V}{80.6mA} = 71.9\Omega \approx 100\Omega$
4. Load current at (**1 KΩ**): $I_L = \dfrac{V_Z}{R_Z} = \dfrac{6.2V}{1K\Omega} = 6.2mA$
5. The zener current: $I_Z = I_S - I_L = 80mA - 6.2mA = 73.8mA$

Table 5.1: Voltage drop across zener diode (with and without load)

Power Supply (Vi)	Voltage Drop (V_0)		
	No Load	**Load = 1KΩ**	**Load = 10KΩ**
1V			
2V			
3V			
4V			
5V			
6V			
7V			
8V			
9V			
10V			
11V			
12V			



Clipping and Clamping Circuits

Objective:

The objective of this experiment is to implement clipping and clamping circuits.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Diode, Capacitor and Resistor.

Background:

By definition, clipping circuits clip signals above a selected voltage level, whereas clamping circuits shift the DC voltage of a waveform. Many wave shapes can be produced with the proper application of these two important diode functions.

Procedure:

1. Connect the circuits as shown in the figures 6.2
2. Launch function generator; set 5Vpp, 100 Hz, Sine wave as shown in the figure 6.1.
3. Observe waveforms using oscilloscope and sketch on the graph paper.
4. Repeat steps 1 to 3 for figures 6.4 and figure 6.6.

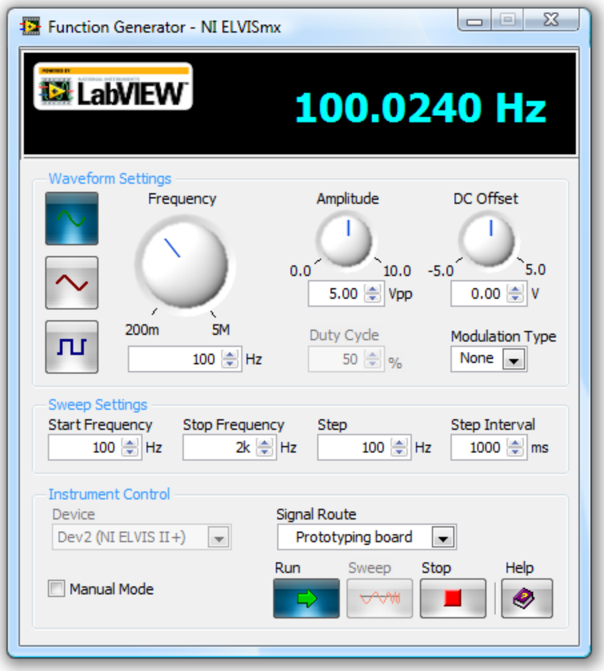


Figure 6.1: NI Elvis II Function Generator.

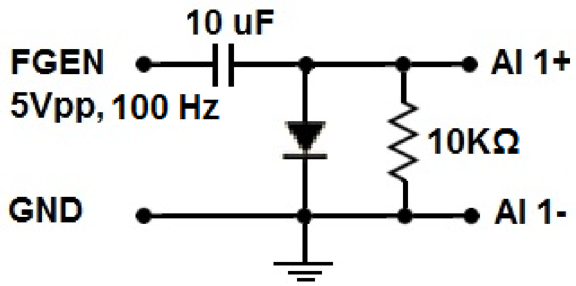


Figure 6.2: Clipping circuit.

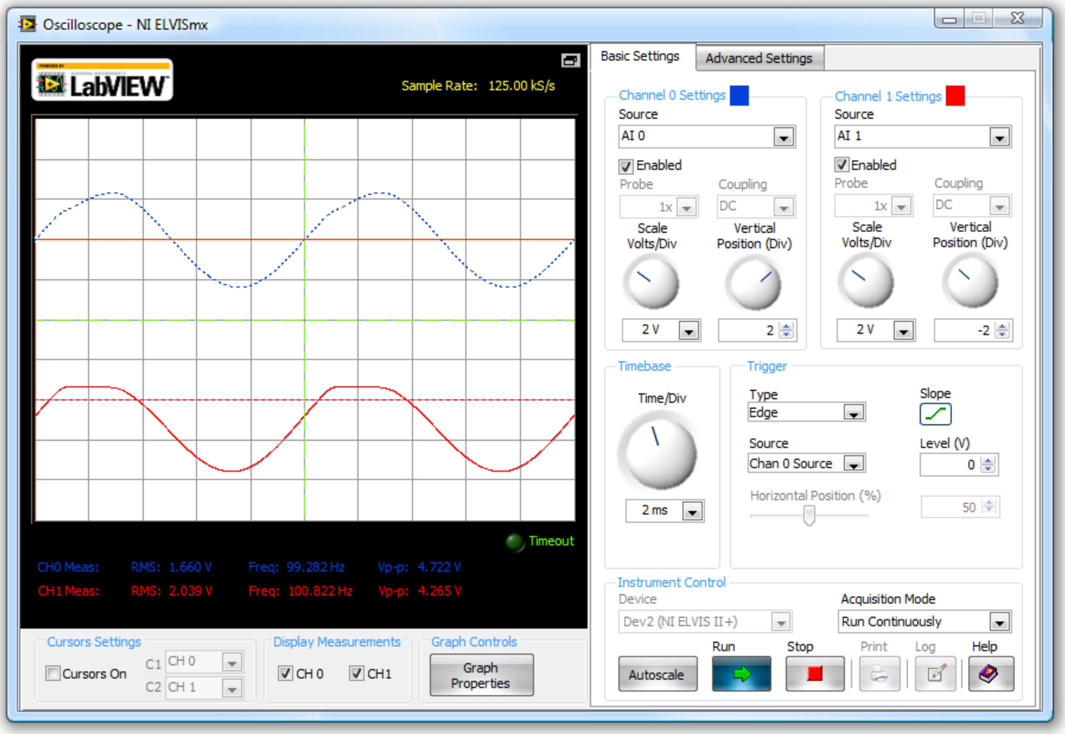


Figure 6.3: Clipping circuit waveform on oscilloscope.

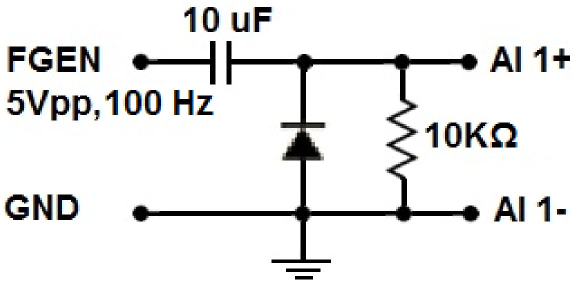


Figure 6.4: Clipping circuit.

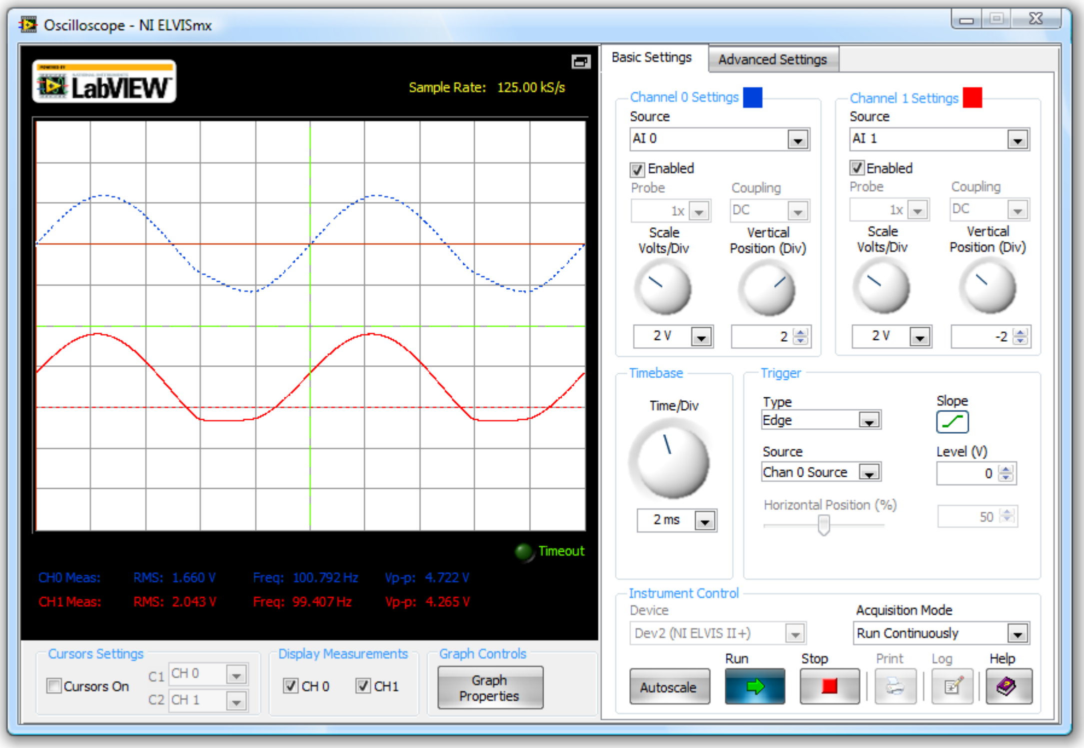


Figure 6.5: Clipping circuit waveform on oscilloscope.

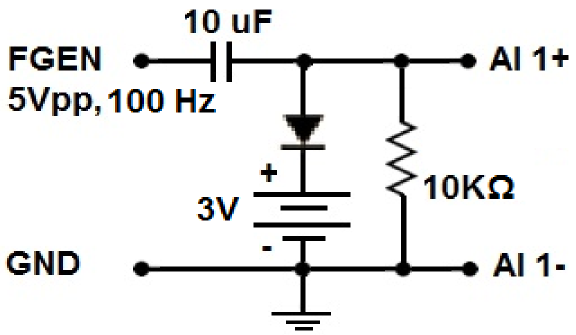


Figure 6.6: Clamping circuit.

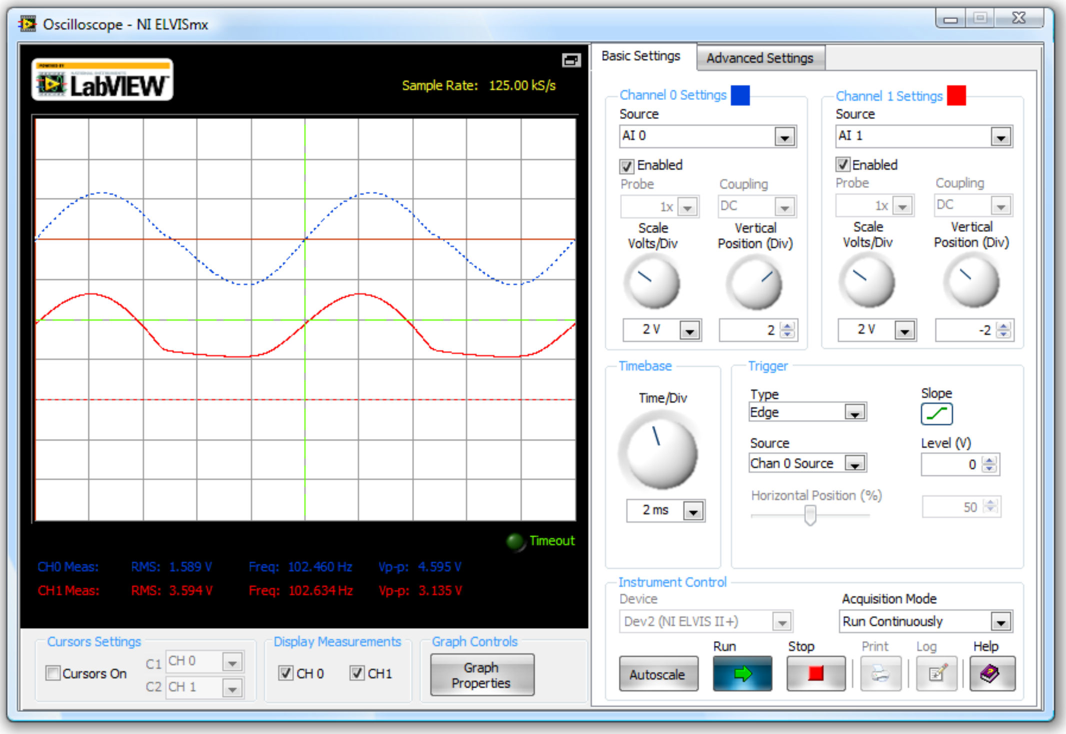


Figure 6.7: Clamping circuit waveform on oscilloscope.

Introduction to Bipolar Junction Transistor

Objective:

The objective of this experiment is to introduce Bipolar Junction NPN & PNP transistors.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. NPN and PNP Transistors.

Background:

A bipolar junction transistor (BJT) is a type of transistor that relies on the contact of two types of semiconductor for its operation. BJTs can be used as amplifiers, switches, or in oscillators. BJTs can be found either as individual discrete components, or in large numbers as parts of integrated circuits. Bipolar transistors are so named because their operation involves both electrons and holes.

Charge flow in a BJT is due to bidirectional diffusion of charge carriers across a junction between two regions of different charge concentrations. The regions of a BJT are called emitter, collector, and base. A discrete transistor has three leads for connection to these regions.

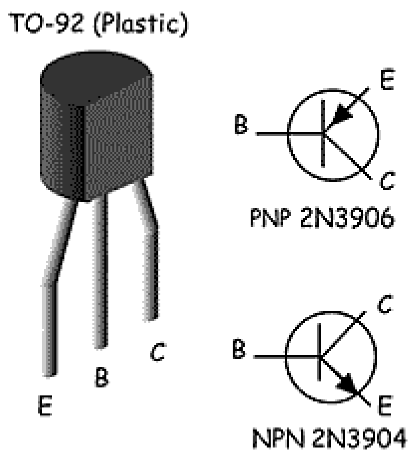


Figure 7.1: NPN and PNP transistor symbols.

Procedure to check transistor using digital multi-meter:

Bipolar transistors are constructed of a three-layer semiconductor "sandwich", either PNP or NPN. As such, a transistor register as two diodes connected back-to-back when tested with a multi-meter "resistance" or "diode check" function as shown in the figure 7.2. Low resistance readings on the base with the black negative (-) leads correspond to an N-type base in a PNP transistor. On the symbol, the N-type material corresponds to the "non-pointing" end of the base-emitter junction, the base. The P-type emitter corresponds to "pointing" end of the base-emitter junction the emitter.

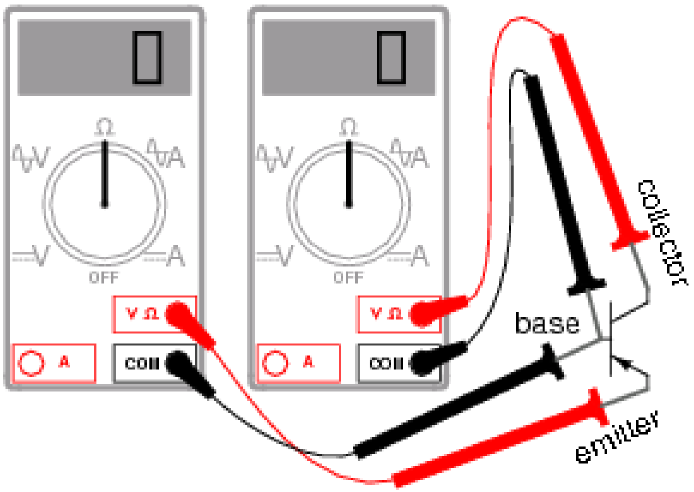


Figure 7.2: PNP transistor meter check forward B-E, B-C, resistance is low

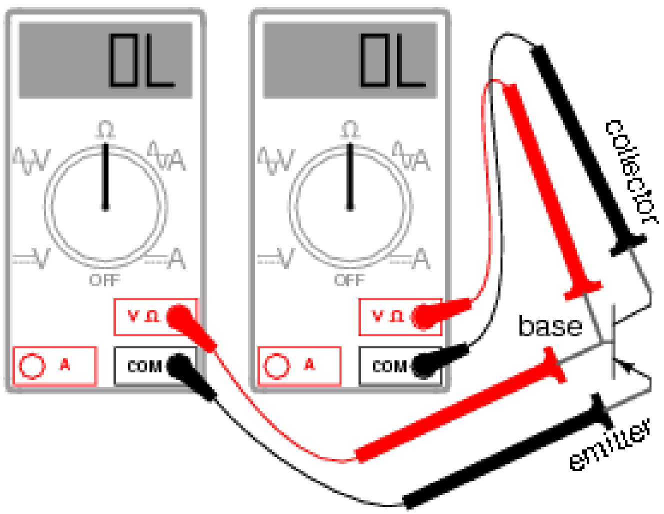


Figure 7.3: PNP transistor meter check reverse B-E, B-C resistance is ∞

If one wire common to both sets of conductive readings, it must be the base connection of the transistor, because the base is the only layer of the three-layer device common to both sets of PN junctions (emitter-base and collector-base). In this example, that wire is number 3, being common to both the 1-3 and the 2-3 test point combinations. In both those sets of meter readings, the black (-) meter test lead was touching wire 3, which tells us that the base of this transistor is made of N-type semiconductor material (black = negative). Thus, the transistor is a PNP with base on wire 3, emitter on wire 1 and collector on wire 2 as described in Figure??

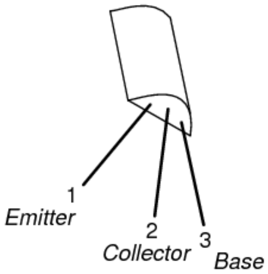


Figure 7.1: PNP transistor meter check forward B-E, B-C, resistance is low

Possible combinations:

1. E and C high R: 1 (+) and 2 (-): “OL”
2. C and E high R: 1 (-) and 2 (+): “OL”
3. E and B forward: 1 (+) and 3 (-): 0.655 V
4. E and B reverse: 1 (-) and 3 (+): “OL”
5. C and B forward: 2 (+) and 3 (-): 0.621 V
6. C and B reverse: 2 (-) and 3 (+): “OL”

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Results:

1. 2N3904 is ____________ type of transistor.
2. 2N3906 is ____________ type of transistor.

Transistor as a Switch

Objective:

The objective of this experiment is to implement transistor as a switch.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Transistors, LED and Resistors.

Background:

Solid state switches are one of the main applications for the use of transistors, and **transistor switches** can be used for controlling high power devices such as motors, solenoids or lamps. In **Bipolar Transistor Switch**, the biasing of the transistor, either NPN or PNP is arranged to operate the transistor at both sides of the “I-V" characteristics curves as shown in the figure 8.1. The areas of operation for a transistor switch are known as the **Saturation Region** and the **Cut-off Region**. The shaded area at the bottom of the curves represents the "Cut-off" region while the area to the left represents the "Saturation" region of the transistor.

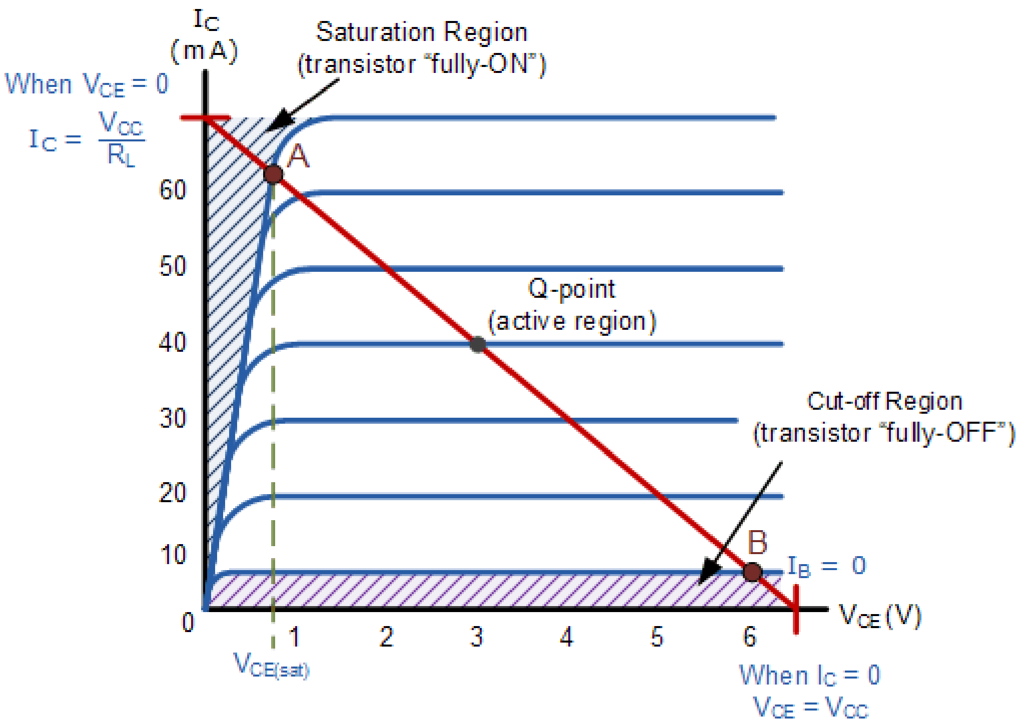
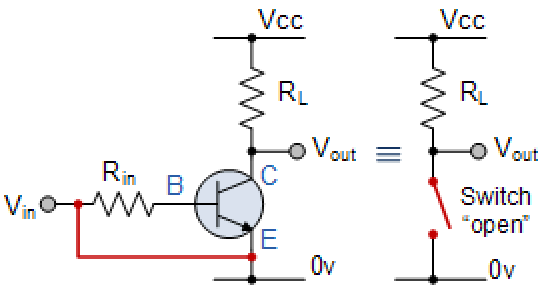
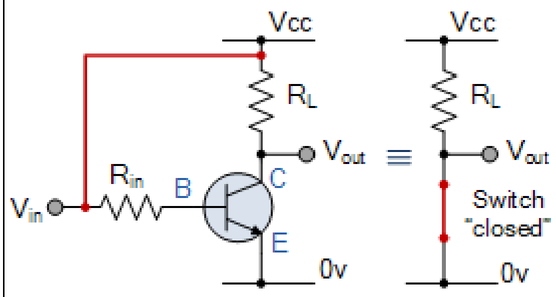


Figure 8.1: Bipolar Junction Transistor operating regions

Cut-off Region	Saturation Region
The operating conditions of the transistor are zero input base current (I_B), zero output collector current (I_C) and maximum collector voltage (V_{CE}) which results in a large depletion layer and no current flowing through the device. Therefore the transistor is switched "Fully-OFF".	The transistor is biased so that maximum amount of base current is applied, resulting in maximum collector current resulting in the minimum collector emitter voltage drop and maximum current flowing through the transistor. Therefore the transistor is switched "Fully-ON".
• The input and Base are grounded (0V) • Base-Emitter voltage V_{BE} < 0.7V • Base-Emitter junction is reverse biased • Base-Collector junction is reverse biased • Transistor is "fully-OFF" (Cut-off region) • No Collector current flows ($I_C = 0$) • $V_{OUT} = V_{CE} = V_{CC}$ = "1" • Transistor operates as an "open switch"	• The input and Base are connected to V_{CC} • Base-Emitter voltage V_{BE} > 0.7v • Base-Emitter junction is forward biased • Base-Collector junction is forward biased • Transistor is "fully-ON" (saturation region) • Max Collector current flows ($I_C = Vcc/R_L$) • $V_{CE} = 0$ (ideal saturation) • $V_{OUT} = V_{CE}$ = "0" • Transistor operates as a "closed switch"
	

Procedure:

1. Connect the circuit as shown in the figures 8.2.
2. Close the switch, observe circuit response and record in table 8.1
3. Repeat steps 1 and 2 for figure 8.3.

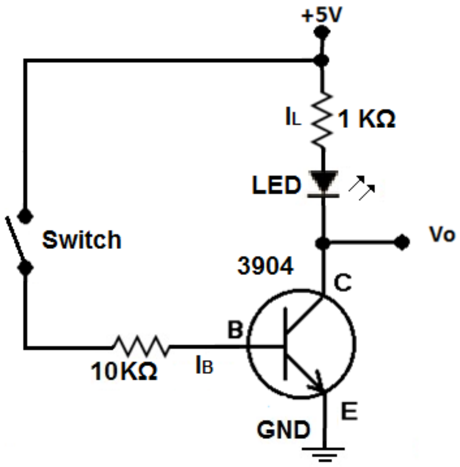


Figure 8.2: NPN transistor as switch.

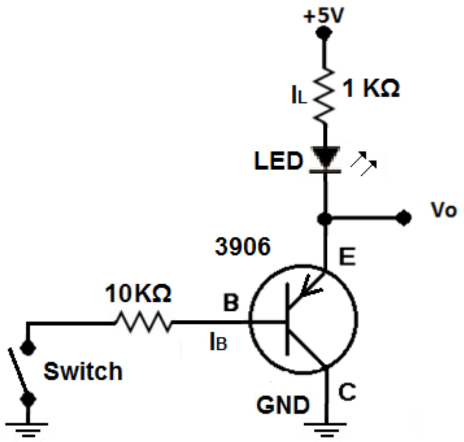


Figure 8.3: PNP transistor as switch.

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Table 8.1: Transistor as a switch.

	When switch is open			When switch is closed		
	V_0	I_B	I_L	V_0	I_B	I_L
Figure 8.2						
Figure 8.3						

Common Emitter Amplifier

Objective:

The objective of this lab is to implement Common Emitter (CE) amplifier.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Transistor, Capacitors and Resistors.

Background:

A common emitter amplifier is one of the three basic single-stage bipolar-junction-transistor (BJT) amplifier topologies, typically it is used as a voltage amplifier. In this circuit the base terminal of the transistor serves as input, the collector is the output, and the emitter is common to both. It gives an inverted output and can have very high gain that may vary widely from one transistor to the next.

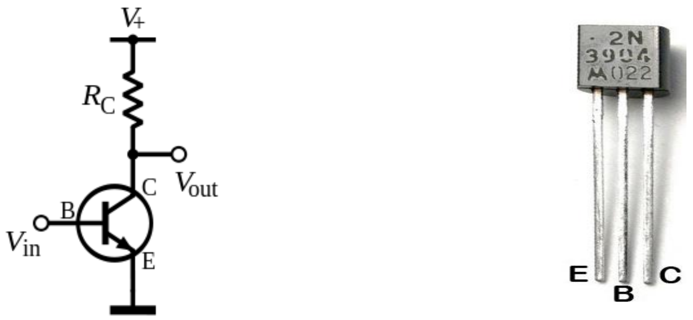

Figure 9.1: Common Emitter Amplifier

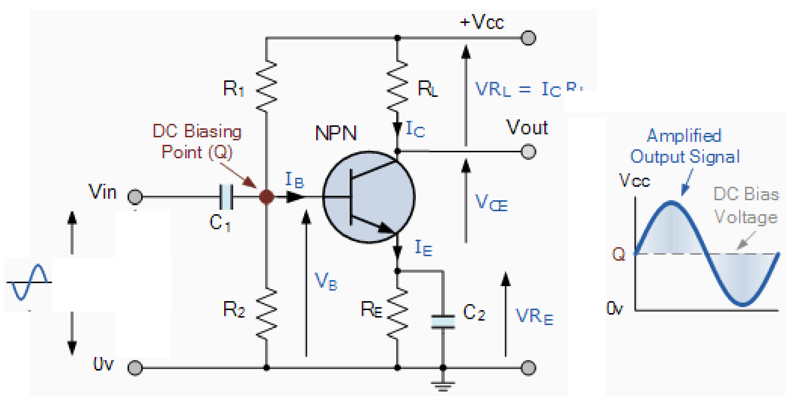

Figure 9.2: A typical Common Emitter Amplifier

Procedure: (CE Amplifier)

1. Connect the circuit as shown in the figure 9.3.
2. Launch function generator from NI launcher and set $2V_{pp}$, 200Hz, Sine wave.
3. Launch oscilloscope select sources AI0 and AI1 for input and output respectively.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper.

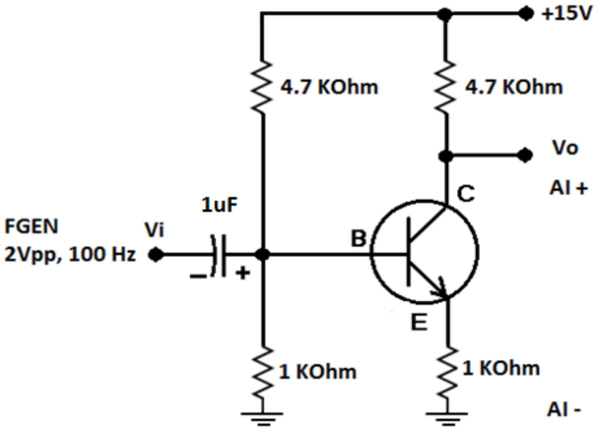

Figure 9.3: Common Emitter Amplifier.

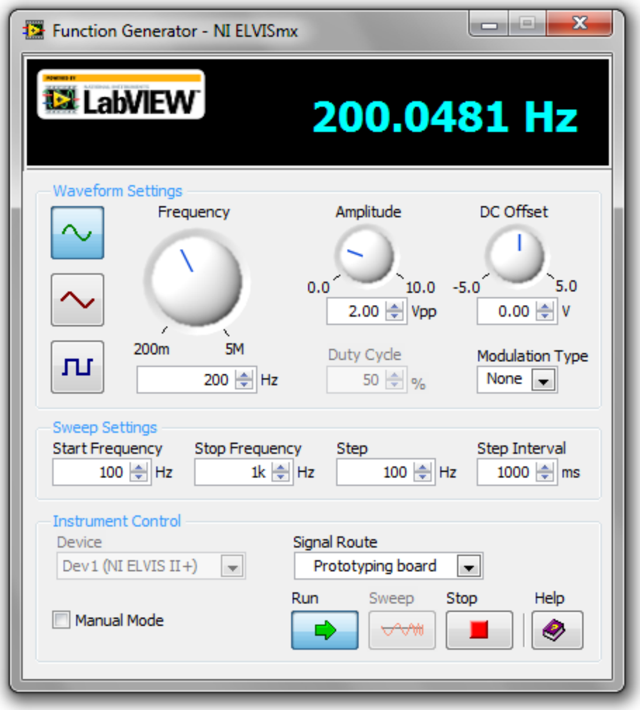

Figure 9.4: NI Elvis II Function Generator

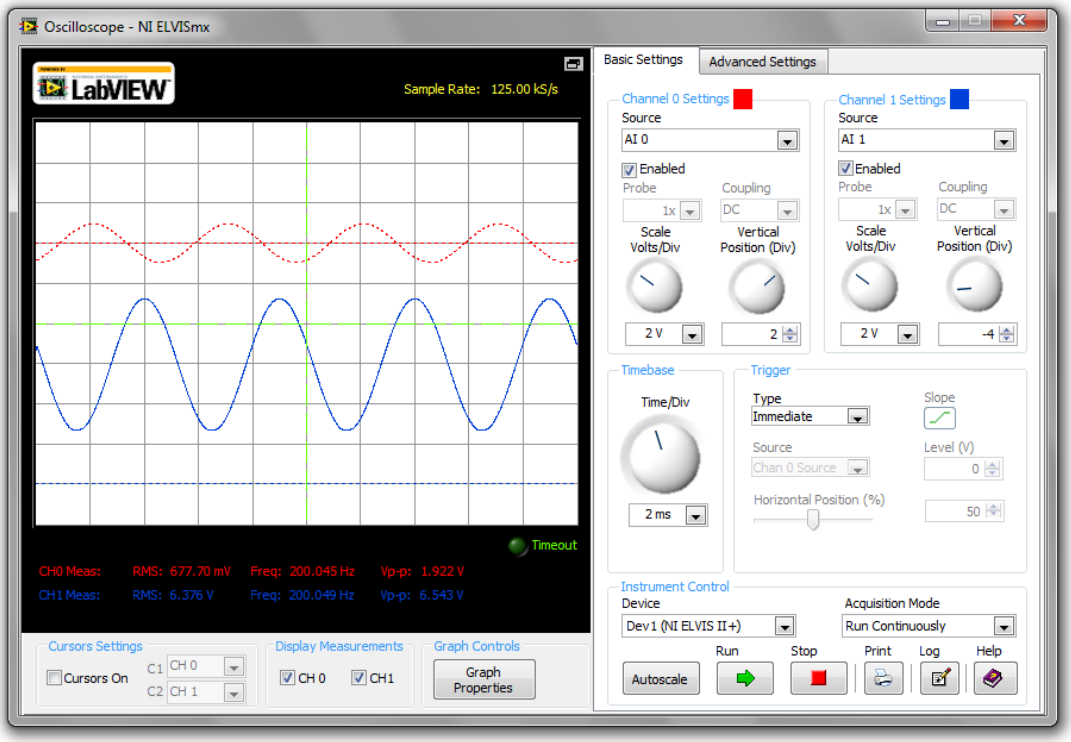

Figure 9.5: Output waveform of Common Emitter Amplifier.

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Common Collector and Common Base Amplifier

Objective:

The objective of this lab is to implement Common Collector (CC) & Common Base (CB) amplifiers.

Equipment:

1. NI ELVIS II Series Prototyping Board.
2. AC/DC Power Supply and USB Cable.
3. Personal Computer.
4. Transistor, Capacitors and Resistors.

Background:

Common Collector Amplifier

The **common collector** amplifier, often called an **emitter follower** since its output is taken from the emitter resistor, is useful as an impedance matching device since its input impedance is much higher than its output impedance. It is also termed a **"buffer"** for this reason and is used in digital circuits with basic gates.

The voltage gain of an emitter follower is just a little less than one since the emitter voltage is constrained at the diode drop of about 0.6 volts below the base. Its function is not voltage gain but current or power gain and impedance matching. Its input impedance is much higher than its output impedance so that a signal source does not have to work so hard. This can be seen from the fact that the base current in on the order of 100 times less that the emitter current. The low output impedance of the emitter follower matches a low impedance load and buffers the signal source from that low impedance.

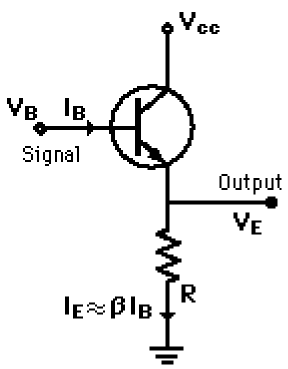

Figure 10.1: Emitter Follower Circuit

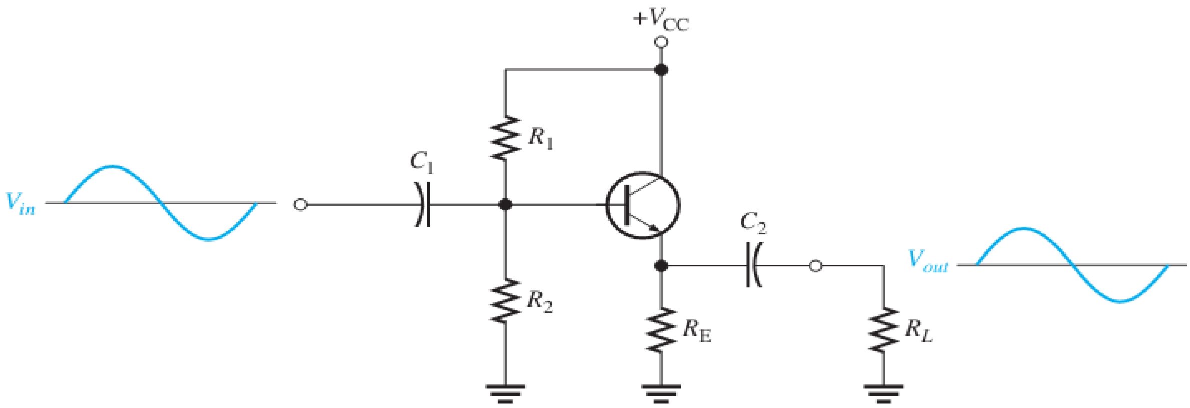

Figure 10.2: A typical Common Collector Amplifier

Common Base Amplifier:

The Common Base amplifier combines low input impedance with comparatively high output impedance. It is also referred as **current follower** or **current buffer**, which senses the current of a low impedance source and efficiently transfers it to a high impedance load.

The CB amplifier offers two crucial advantages over the CE amplifier:

- It can provide higher output impedance and can act as a high quality current source.
- The parasitic capacitance between collector and base does not impact the high frequency performance, which can result in more bandwidth.

If the CB amplifier is used as a voltage gain stage, it demands a low source impedance to maintain a high voltage gain.

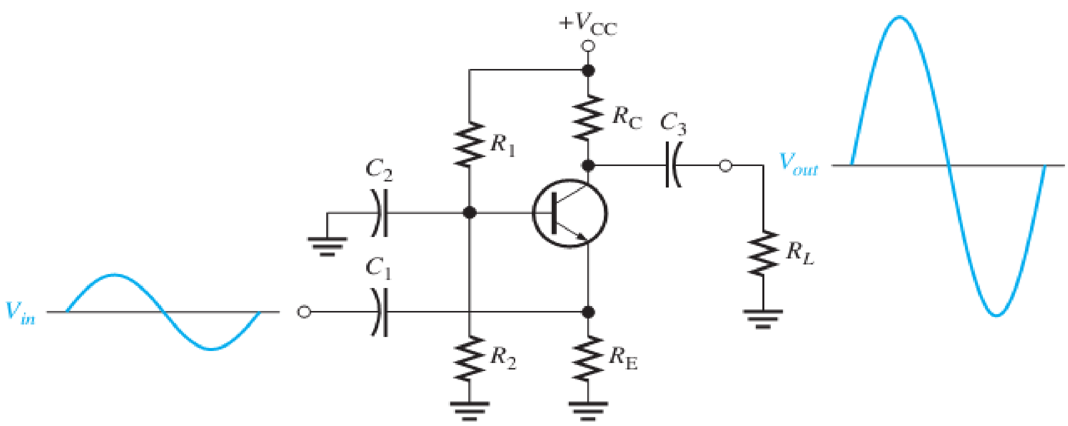

Figure 10.3: A typical Common Base Amplifier

Procedure: Part I (CC Amplifier)

1. Connect the circuit as shown in the figure 10.4.
2. Launch function generator from NI launcher and set $2V_{pp}$, 200Hz, Sine wave.
3. Launch oscilloscope select sources AI0 and AI1 for input and output respectively.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper.

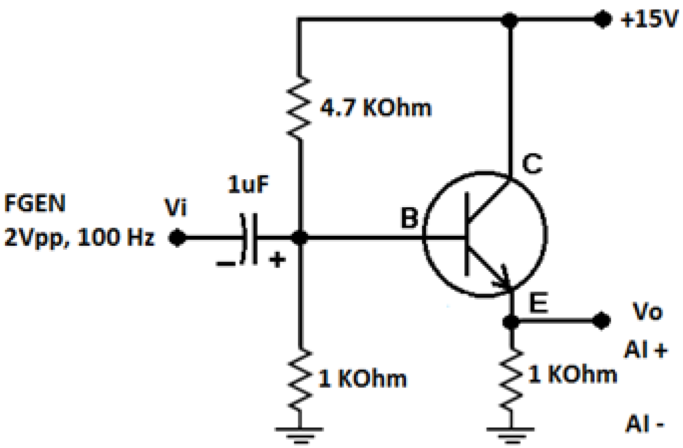

Figure 10.4: Common Collector Amplifier

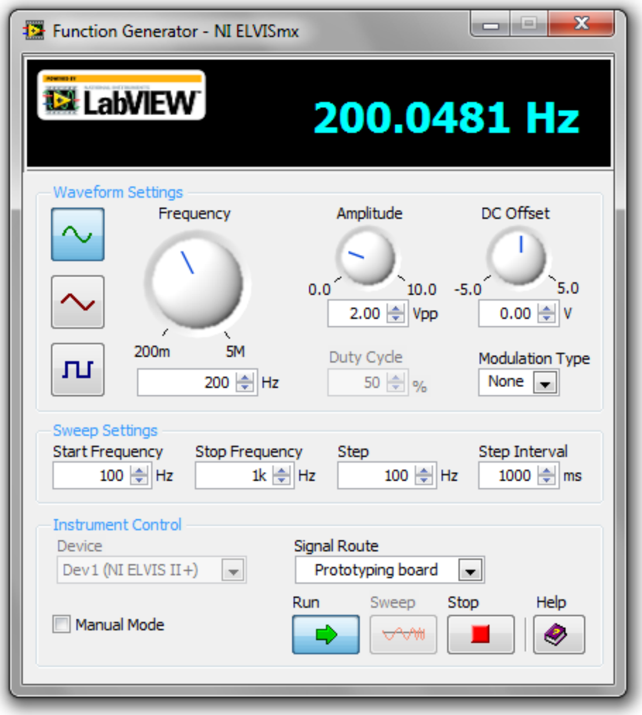

Figure 10.5: NI Elvis II Function Generator

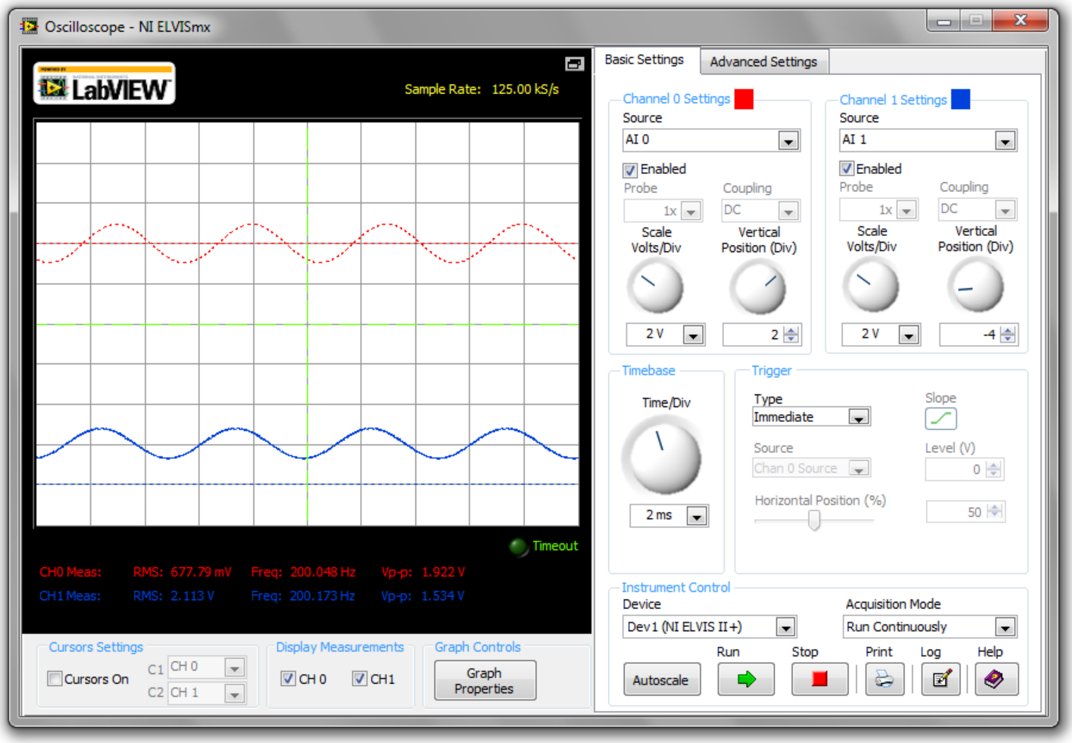

Figure 10.6: Output waveform of Common Collector Amplifier.

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Procedure: Part II (CB Amplifier)

1. Connect the circuit as shown in the figure 10.7.
2. Launch function generator from NI launcher and set $1V_{pp}$, 200Hz, Sine wave.
3. Launch oscilloscope select sources AI0 and AI1 for input and output respectively.
4. Observe the waveform using oscilloscope.
5. Sketch the waveform on the graph paper.

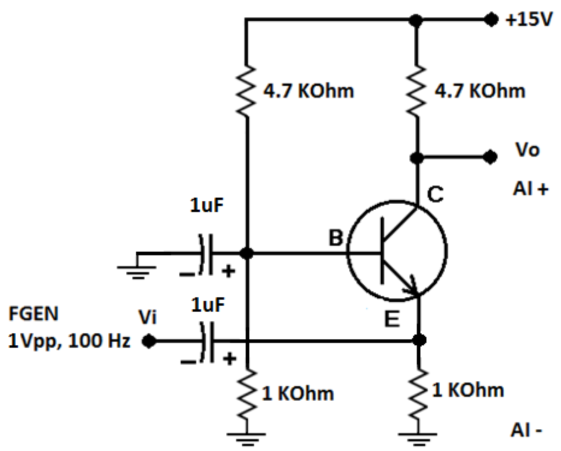

Figure 10.7: Common Base Amplifier

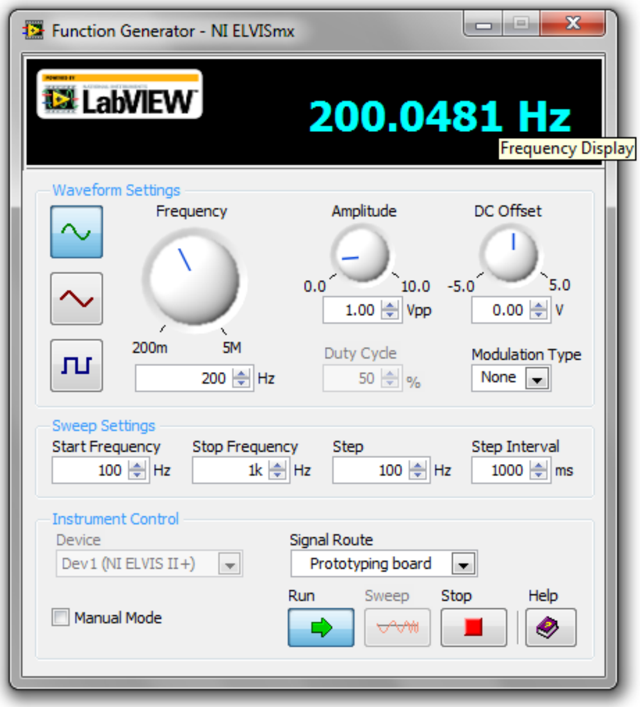

Figure 10.8: NI Elvis II Function Generator.

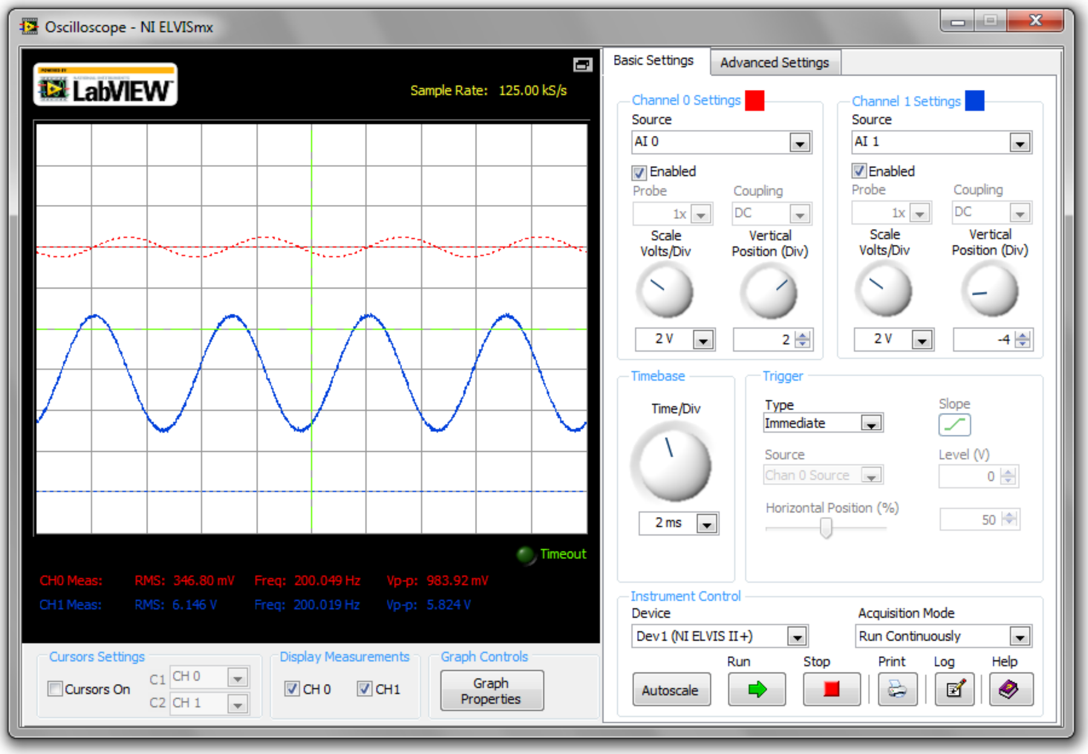

Figure 10.9: Output waveform of Common Base Amplifier

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Summary